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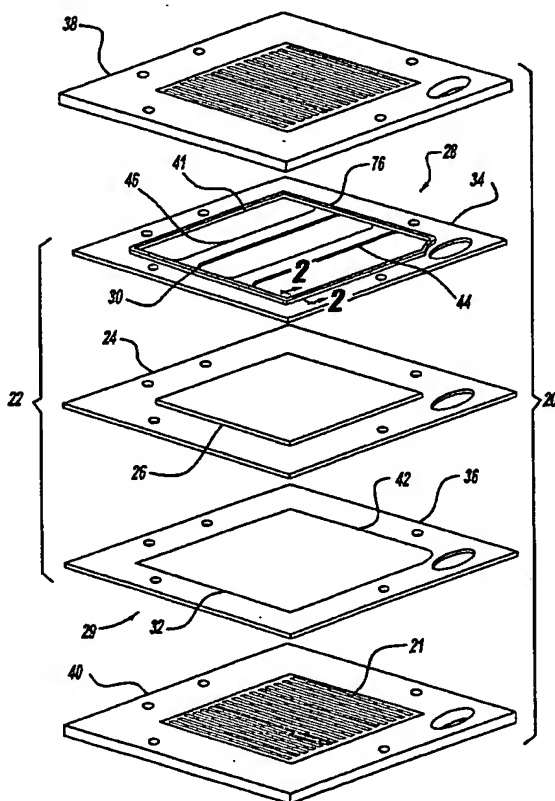
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- (71) Applicant (for all designated States except US):
**FREUDENBERG-NOK GENERAL PARTNER-
SHIP [US/US]; 47690 East Anchor Court, Plymouth, MI
48170-2455 (US).**
- (72) Inventors; and
(75) Inventors/Applicants (for US only): **KOCH, Steve
George [US/US]; 13382 North Lake Road, Gregory, MI
48137-9623 (US). SMITH, Jeffrey Alan [US/US]; 1084
Long Leaf Court, Brighton, MI 48116 (US).**
- (74) Agent: **WANGEROW, Ronald W.; Freudenberg-NOK
General Partnership, Intellectual Property Department,
47690 East Anchor Court, Plymouth, MI 48170-2455
(US).**
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[Continued on next page]

(54) Title: FUEL CELL SEAL WITH INTEGRAL BRIDGE



(57) Abstract: The invention is drawn to a gasket (34) for use in an individual fuel cell (20). The gasket (34) includes at least one generally rigid bridge (44) or (46) that extends across the fluid flow channels in adjacent separator plates (38) and (40). The bridge (44) or (46) assures that the fluid flow channels are not blocked or restricted in the cell (20). Each bridge (44) or (46) may be integral with its corresponding gasket (34). The gasket (34) may be a multi-piece gasket with a carrier material having an elastomeric seal portion (74) secured to it.

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- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations
- of inventorship (Rule 4.17(iv)) for US only

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD,

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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FUEL CELL SEAL WITH INTEGRAL BRIDGE

BACKGROUND OF INVENTION

This invention relates in general to static seals and more particularly to a gasket employed for sealing between components in a fuel cell.

A fuel cell is an electrochemical energy converter that includes two electrodes placed
5 on opposite surfaces of an electrolyte. In one form, an ion-conducting polymer electrolyte membrane is disposed between two electrode layers (also sometimes called gas diffusion layers), with layers of a catalyst material between the membrane and the electrode layers, to form a membrane electrode assembly (MEA). The MEA is used to promote a desired electrochemical reaction from two reactants. One reactant, oxygen or air, passes over one
10 electrode while hydrogen, the other reactant, passes over the other electrode. The oxygen and hydrogen combine to produce water, and in the process generate electricity and heat.

An individual cell within a fuel cell assembly includes a MEA placed between a pair of separator plates (also sometimes called flow field plates). The separator plates are typically fluid impermeable and electrically conductive. Fluid flow passages or channels are
15 formed adjacent to each plate surface at an electrode layer to facilitate access of the reactants to the electrodes and the removal of the products of the chemical reaction.

In such fuel cells, resilient gaskets or seals are typically provided between the faces of the MEA and the perimeter of each separator plate to prevent leakage of the fluid reactant and product streams. Since the fuel cell operates with oxygen and hydrogen, it is important to
20 provide a seal that not only seals well against hydrogen, oxygen and water, but that will seal well as the temperature changes due to the heat that is given off during fuel cell operation. To assure a good seal, the seals need to be formed accurately as well as aligned properly with the other components. In particular, the gaskets can be difficult to assemble into a cell because they are flexible and may have a tendency to bend or twist. This can make proper
25 alignment of the cell components time consuming and prone to misassembly. Moreover, in order to assure a good seal around the entire gasket, a certain amount of force (a sealing force) is applied to hold the separator plates against the gaskets. But this may cause portions of the gasket to be pressed into the fluid flow channels of the separator plates, which restricts the flow channels in the separator plates.

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Thus, it is desirable to have a gasket of an individual cell of a fuel cell that is relatively easy to align during an assembly operation while assuring the proper sealing for the finished assembly, and which will not interfere with the flow channels in the separator plate.

SUMMARY OF INVENTION

5 In its embodiments, the present invention contemplates an apparatus for use in an individual cell that includes a gasket having opposed sides about a perimeter, with the gasket including at least one generally rigid bridge extending between the opposed sides.

The present invention further contemplates an individual cell adapted for use in a fuel cell assembly having a membrane electrode assembly including a first gasket mounted about
10 a first gas diffusion layer and a second gasket mounted about a second gas diffusion layer. A first separator plate includes a first set of flow channels, and a second separator plate including a second set of flow channels; wherein the first gasket includes at least one first generally rigid bridge extending adjacent the first set of flow channels, and the second gasket includes at least one second generally rigid bridge extending adjacent the second set of flow
15 channels.

The present invention also contemplates a method of assembling a gasket to a separator plate that has fluid flow channels, the method comprising the steps of: forming a generally rigid bridge on the gasket; locating the bridge adjacent the fluid flow channels; and compressing the gasket against the separator plate with a sealing load.

20 An advantage of the present invention is that a gasket component having a bridge adjacent to channels in a separator plate will significantly reduce or eliminate gasket material being forced into the channels. Thus, the flow of fluids in the channels is not reduced or blocked, while still allowing for the required sealing force between the gasket and other cell components.

25 Another advantage of the present invention is that the bridge, being preferably integrally molded to the gasket, will not add to the number of components that need to be assembled to form an individual cell.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is an schematic, exploded, perspective view of an individual cell of a fuel cell
30 assembly;

Fig. 2 is a partial, sectional view of a gasket assembly, taken along line 2-2 in Fig. 1;

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Fig. 3 is a plan view of a gasket and gas diffusion layer in accordance with another embodiment of the present invention; and

Fig. 4 is a schematic, sectional view of a portion of a gasket and separator plate.

DETAILED DESCRIPTION

5 Figs. 1-2 illustrate an individual cell 20 for use in a fuel cell assembly. The individual cell 20 preferably includes a gasket unitized membrane electrode assembly (MEA) 22, (although the gasket may be separate rather than unitized, if so desired). The MEA 22 is made up of a membrane 24, with a layer of catalyst material 26 on both sides of the membrane 24. The MEA 22 also includes a first gas diffusion layer (GDL) 30 and second
10 GDL 32 on either side of the layers of catalyst material 26, and a first gasket 34 and a second gasket 36, secured around the perimeters 41, 42 of the first GDL 30 and the second GDL 32, respectively. Preferably, the gaskets 34, 36 are secured to the GDLs 30, 32 by adhesive, although other means of securing may be used if so desired, such as molding each gasket to its GDL. Each GDL 30, 32 and its corresponding gasket 34, 36 forms a unitized seal-
15 diffusion assembly 28, 29, respectively. The unitized seal-diffusion assemblies 28, 29 are preferably secured to the membrane 24 with an adhesive, although other means of securing may also be employed. A first separator plate 38 mounts against the first gasket 34 and the first GDL 30, and a second separator plate 40 mounts against the second gasket 36 and the second GDL 32, in order to form the individual cell 20. Since the relative thicknesses of the
20 various components are very thin, they are only depicted schematically in the figures in order to aid in describing the invention. The actual thicknesses of the components may vary according to the particular application of the fuel cell and are known to those skilled in the art. Also, the components of the cell 20 are generally symmetric about the membrane 24.

The membrane 24 is preferably an ion-conducting, polymer, electrolyte membrane, as
25 generally employed in this type of fuel cell application. The catalyst material 26 is preferably platinum or other suitable catalyst material for a typical polymer electrode membrane type of fuel cell application. The first and second GDLs 30, 32 are preferably a carbonized fiber, or may be another suitable gas permeable material for use as an electrode in a fuel cell. The MEA 22 can include a catalyzed membrane with GDLs assembled thereto, or a membrane
30 assembled between two catalyzed GDLs, each of which is known to those skilled in the art.

The gaskets 34, 36, are each preferably a multi-piece gasket with a thin, flexible carrier 72 upon which an elastomeric seal 74 is secured – with the elastomeric seal 74

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preferably including a sealing bead 76 projecting therefrom, (only one shown in Figs. 1 and 2). The carrier 72 preferably has a thickness of less than 1.0 millimeters and is preferably made from a polymeric material – although, optionally, a polymer or a thin layer of metal may be employed instead, if so desired. The elastomeric seal 74 is preferably molded to the carrier 72, although other means of securing the two may also be employed. The sealing bead 76 is compressed against the surface of its corresponding separator plate 38, 40 and held with sufficient sealing force to prevent migration of fluid past the seal along the surface of the particular separator plate 38, 40. While the sealing bead 76 is shown in the shape of a triangle, different shapes may also be employed, if so desired. Also, as an alternative, the gaskets 34, 36, may be a single molded piece, rather than a multi-piece assembly. Further, as an alternative, the carrier 72 may include elastomeric gaskets secured on both sides rather than just one elastomeric seal, thus reducing the adhesive needed for securing and sealing cell components together.

The first and second separator plates 38, 40 are generally rectangular in shape, although other shapes can also be employed if so desired. Each plate includes fluid flow channels 21 to facilitate access of the reactants to the electrodes (gas diffusion layers) and the removal of the products of the chemical reaction. The plates 38, 40 have outer surfaces that are made to mate with adjoining individual cells in order to make up a completed fuel cell assembly.

The first gasket 34 includes a first bridge 44 and a second bridge 46, and the second gasket 36 also includes the same bridges, not illustrated in Figs. 1 and 2. While two bridges 44, 46 are shown, any number of bridges may be employed, as is desired to accomplish the objective. Each bridge 44, 46 extends across its unitized seal diffusion assembly 28, 29, and is formed of a material that is sufficiently rigid to avoid being pressed into the fluid flow channels 21. The bridges 44, 46 are preferably integrally molded with its corresponding gasket 34, 36 in order to simplify the assembly of the cell 20, but they may be separate, if so desired.

Figs. 3 and 4 illustrate another embodiment of the present invention. In this embodiment, similar elements to the first embodiment will be similarly designated, but with a 100 series number. The separator plate 140 mates with the gasket 136, with the gasket 136 surrounding the flow channels 121. A pair of rigid inserts 144, 146 are included with the gasket 136 and extend transversely across the channels 121 in order to assure that there are no blockages formed in the channels 121 when the sealing pressure is applied to the cell 120.

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While certain embodiments of the present invention have been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

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CLAIMS

What is claimed is:

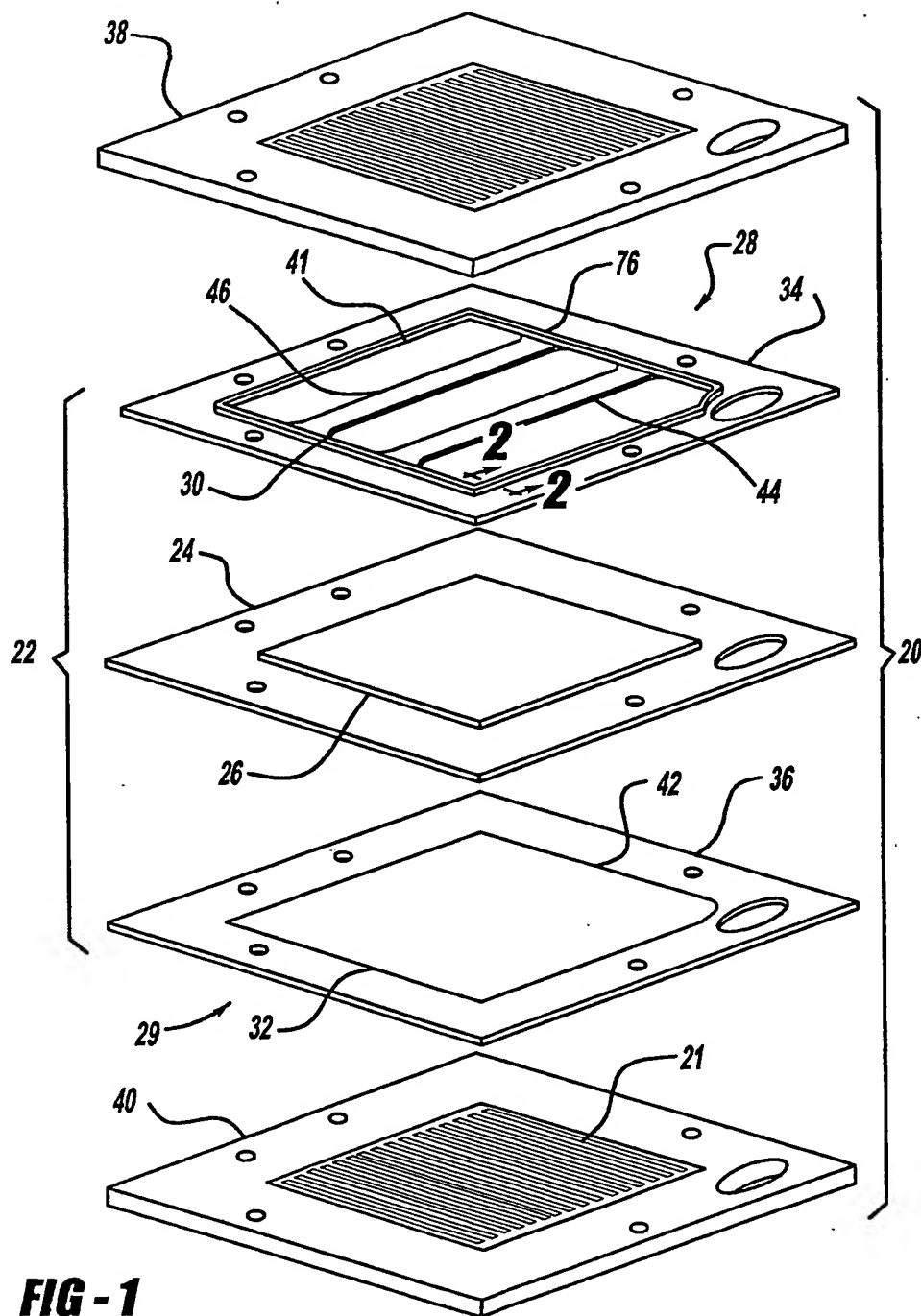
1. An apparatus for use in an individual cell comprising:
a gasket including opposed sides about a perimeter, with the gasket including
5 at least one generally rigid bridge extending between the opposed sides.
2. The apparatus of claim 1 further including a gas diffusion layer having a
perimeter, and with the gasket shaped to surround and mate with the perimeter of the gas
diffusion layer.
3. The apparatus of claim 1 wherein the gasket includes a carrier layer and an
10 elastomeric seal layer mounted thereto.
4. The apparatus of claim 1 wherein the bridge is integral with the gasket.
5. The apparatus of claim 1 wherein the at least one bridge is two bridges.
6. An individual cell adapted for use in a fuel cell assembly comprising:
a membrane electrode assembly including a first gasket mounted about a first
15 gas diffusion layer and a second gasket mounted about a second gas diffusion layer;
a first separator plate including a first set of flow channels;
a second separator plate including a second set of flow channels; and
wherein the first gasket includes at least one first generally rigid bridge
extending adjacent the first set of flow channels, and the second gasket includes at least one
20 second generally rigid bridge extending adjacent the second set of flow channels.
7. The individual cell of claim 6 wherein the first generally rigid bridge is
integral with the first gasket.
8. The individual cell of claim 7 wherein the second generally rigid bridge is
integral with the second gasket.
- 25 9. The individual cell of claim 6 wherein the first gasket includes a carrier layer
and an elastomeric seal layer mounted thereto.
10. The individual cell of claim 9 wherein the second gasket includes a carrier
layer and an elastomeric seal layer mounted thereto.
11. A method of assembling a gasket to a separator plate that has fluid flow
30 channels, the method comprising the steps of:
forming a generally rigid bridge on the gasket;
locating the bridge adjacent the fluid flow channels; and
compressing the gasket against the separator plate with a sealing load.

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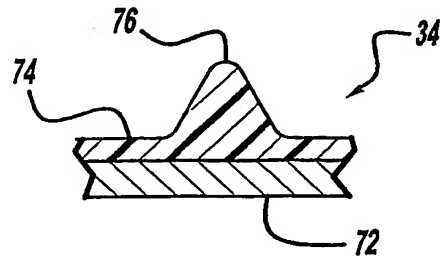


FIG - 2

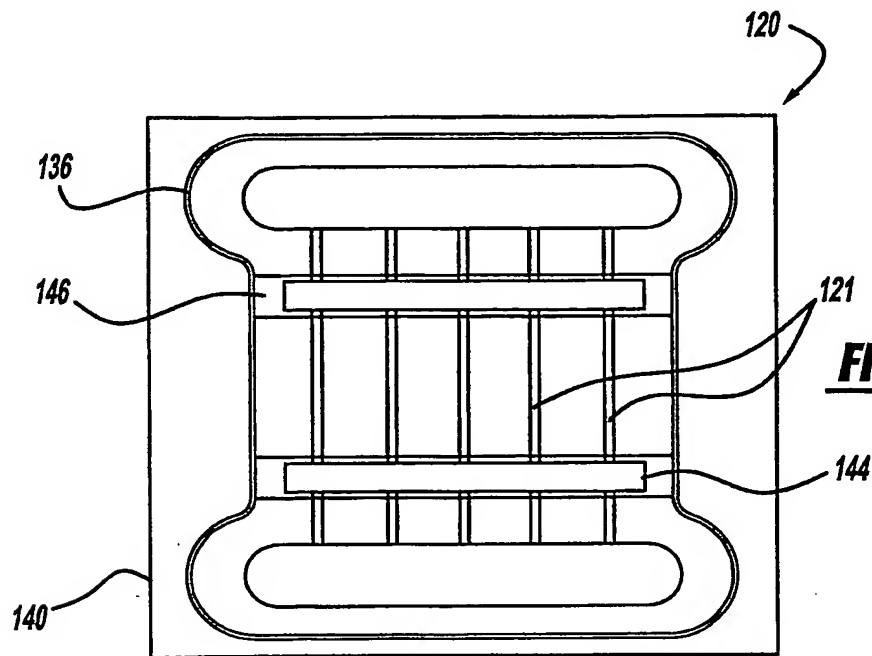


FIG - 3

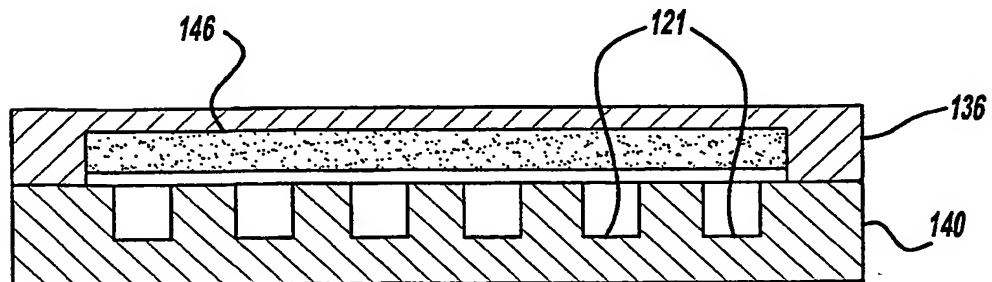


FIG - 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/41287

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : F16J 15/02; H01M 2/14, 08/02
 US CL : 277/628, 637, 639, 644, 650; 429/34, 35, 36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 277/628, 637, 639, 644, 650; 429/34, 35, 36

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,437,785 A (PUCCIO) 20 March 1984 (20.03.1984), Fig. 1.	1, 4 and 5
X — Y	JP 07-220742-A (MATSUSHITA ELECTRIC IND. CO. LTD.) 18 August 1995 (18.08.1995), abstract and Figures.	1-5 and 11 6-10
X — Y	US 3,231,289 A (CARRELL) 26 January 1962 (26.01.1962), Fig. 1.	1 and 3 5
X	US 4,735,718 A (PETERS) 04 April 1988 (05.04.1988), Fig. 1.	1, 4 and 5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

08 June 2004 (08.06.2004)

Date of mailing of the international search report

23 JUN 2004

Name and mailing address of the ISA/US

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 Commissioner for Patents
 P.O. Box 1450
 Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

Gregg Cantelmo

Telephone No. 571-272-1283

INTERNATIONAL SEARCH REPORT

International application No.

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Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☒

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

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BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-5, drawn to a gasket.

Group II, claim(s) 6-10, drawn to a fuel cell.

Group III, claim(s) 11, drawn to a method of assembling a gasket to a plate.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I lacks the same special technical features of Group II (such as an MEA and separator plate) and Group II (separator plate).

Group II lacks the same special technical features of Groups I and II (such as a bridge extending between opposing sides of the gasket).

Group III lacks the same special technical features of Groups I and II such as a gasket including opposed sides about a perimeter with the gasket including at least one generally rigid bridge extending between opposed sides (Group I) and an MEA and first and second separator plates (Group II) >